MODULAR STUDY TABLE

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SUPERVISOR'S DECLARATION

We hereby declare that we have checked this project and in our opinion this project is satisfactory in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering.

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STUDENT DECLARATION

I declare that this thesis entitled *modular study table* is the result of my own research except cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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Dedicated to my beloved:

Father,

Mother,

Younger brother

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ABSTRACT

The problem to the existing table nowadays is it is fix or limited to number of person that can use it in the same time. The space for it cannot be adjusted to accommodate more people then it supposed to. The user has to find other solution such as providing another table if the current table cannot fulfill the number of people. The purpose of this project is to design and develop a study table that can be manipulated in term of the space that the table can provide according requirement. In this project, the table would be able to support amount of user from single person till four person max at a time. The use of the table can be modulated from a single person to a group of four people. Single person would use smaller space compared to a group of four people. The variable condition makes the usage requirement varies from time to time. The objective of this project is to design, analyse the structure and lastly to fabricate the flexible table that can fill the needs from user. The scope of work is to draw the parts for the table by using Solidworks software, assemble all the parts into a table in the Solidworks, build the real structure of the table (by parts), and use the ALGOR software to analyse the structure. In the analysis, it is mainly to determine the value of maximum yield stress the table can support for each case from single person study table to maximum four person study table. In the analysis, the maximum value from software analysis is 107.866MPa, happens in the four person usage case. The value is acceptable due to the yield strength of the material used, aluminum, is 325MPa. Displacement for the structure can also be observed in ALGOR analysis for all three cases. Displacement of 9.4mm is observed in simulation for four person usage and this value is still acceptable for construction. The table did form the shape planned but the surface of the table tend to bend even without the load. The deformation can clearly spotted visually relative to a straight object.

ABSTRAK

Masalah yang timbul dengan meja sedia ada pada masa sekarang ialah jumlah pengguna yang boleh menggunakan meja tersebut pada suatu masa yang sama adalah terhad. Ruang yang sedia ada tidak boleh diubah suai untuk membolehkan lebih ramai pengguna menggunakannya pada masa yang sama. Pengguna terpaksa mencari jalan penyelesaian lain seperti menyediakan meja yang lain sekiranya meja yang sedia ada tidak boleh menampung jumlah pengguna. Tujuan utama projek ini ialah untuk merekabentuk dan membangunkan sebuah meja belajar yang boleh dimanipulasikan dari segi keluasan ruang sepertimana yang diperlukan. Dalam projek ini, meja tersebut dapat menampung jumlah pengguna dari seorang hingga empat orang. Ruang yang diperlukan bagi seorang pengguna adalah lebih kecil jika dibandingkan dengan empat orang pengguna. Kepelbagaian keadaan menyebabkan tahap penggunaan berubah dari semasa ke semasa. Objektif projek ini adalah untuk merekabentuk, menganalisis struktur dan seterusnya membina sebuah meja fleksibal yang boleh memenuhi kehendak pengguna. Skop projek ini adalah melukis bahagian – bahagian meja dengan menggunakan perisian Solidworks, menyantumkan semua bahagian meja dalam Solidworks, membina struktur sebenar meja (mengikut bahagian), dan menggunakan perisian ALGOR untuk menganalisis struktur. Di dalam analisis, tujuan utamanya ialah untuk menentukan nilai maksimum stress yield yang boleh ditampung untuk setiap kes dari penggunaan persendirian sehingga maksimum empat orang. Mengikut analisis, nilai maksimum yang diperolehi dari perisian ALGOR ialah 107.866MPa, iaitu pada kes empat pengguna. Nilai tersebut boleh diterima kerana nilai kekuatan yield untuk material aluminium adalah 325MPa. Sesaran untuk struktur juga boleh dilihat melalui perisian ALGOR untuk ketiga – tiga kes. Menurut perisian ALGOR, sesaran sebanyak 9.4mm berlaku pada kes empat pengguna dan nilai ini masih lagi boleh diterima bagi tujuan pembinaan struktur sebenar. Meja tersebut dapat dibina sepertimana dirancangkan tetapi permukaan meja melengkung walaupun tanpa sebarang beban dikenakan keatasnya. Lengkungan tersebut dapat dilihat dengan jelas berpandukan objek yang lurus.

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CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

Table is very important furniture in today's life. From application in office to household usage, it is widely used all over the world. Its contribution to men kind cannot be denied at all.

Nowadays, tables are widely used. From office usage to household item, table is important to us. At office, it used as a tool to put items and as a workplace to work at, and as for home, as a dining table, studying table and etc.

But the usage of that thing is not limited for placing item of the floor or eating session, it usage has spread. It even has been acknowledge as a collectable item, object for decoration, and other usages. Some of the table has high value and considered a fine piece of art, collected as an antique collection. [4]

Although the usage of table are huge, there still some adjustment can be done to the current table to make that it is even more flexible and versatile then current table. In other word, table that have the senses of nowadays life.

1.2 PROBLEM STATEMENT

Firstly, the table is hard to be stored if it didn't be used due to its flexibility is limited. The table is useful only when the user needed to use it, but if the user done with it, he or she cannot or hard to store it away. Due to its size and shape, it is difficult to store it. Nowadays

living space like houses and condominium are getting more and more expensive. Not all people can afford to stay in a huge home. Due to this problem, space is important to manage. [5]

Second, the size of the table is fixed and cannot be change according to event involving it. It cannot be change following the occasion needed by its owner. For example, for dining purposes, it is only proper to be used for dining occasion only, other function also can be done but it would be awkward. “Tables come in a wide variety of shapes, height, and materials, depending on their origin, style, and intended use.” [5]

Third problem involving table is it cannot balance itself if the floor surface isn’t smooth. The table will shake and become imbalance. This will disturb the situation at that time.

Problem number four that involve the table is it is fix or limited to number of person that can use it in the same time. The space for it cannot be adjusted to accommodate more people then it supposed to. The user has to find other solution such as providing another table if the current table cannot fulfill the number of people.

These problems cannot totally be eliminated but surely can be minimized. A lot of work must be taken to overcome the problem regarding the table.

The table that will be developed will be able to solve the fourth problem that has been stated in the project background. The products which uses the concept of modular, is an approach aiming to subdivide a system into smaller parts (modules) that can be independently created and then used in different systems to drive multiple functionalities. The current table has several same characteristic which is made from a piece of material that cannot be fold or flip and certainly cannot be added the length of its surface.

The length of the table limit the application can be handled by the table. Small table cannot be used to put a lot of things at the same time. The space for the application is limited. This makes the user must find another table to support the current table for the certain function. That will cause the user to spend unnecessarily for another table.

For the normal table, the table has problem when it is tried to be move from one room to another. It must be torn apart before any movement can be done. The normal table are not meant to be taken to pieces will eventually damaged if the process done several time. It will cause the product to shorten its durability.

The normal table are not meant to be stored after used but this would bring problem to people that has no or limited space in their home. The space that has been occupied by the table is quite large and if the table can be stored after it's been used, the space would be able to be used for other purposes.

So, we can see that this problem can cause some serious problem to all users and must be solve to make sure all people life in better life. This problem surely can be solved by replacing the old table with this newly improved modular based table.

1.3 PROJECT OBJECTIVES

In the course of completing this project, there are a few objectives to be fulfilled. These are:

I. To analyze the structure by using analysis software
ii. To design and develop a flexible-area table.

1.4 PROJECT SCOPE

i. Design a study purpose table using the concept of modularity.
ii. Draw the parts for the table by using Solidworks software.
iii. Assemble all the parts into a table in the Solidworks
iv. Build the real structure of the table (by parts)
v. Use the ALGOR software to analyse the structure

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter will explain the development process of a table. Brief information about the history, types, design and material used will be explained. This chapter will also discuss about

the previous project that is related to the topic. Lastly, a modular design for a study table will be discussed.

2.2 MODULARITY

Modularity is a concept that can be applied in huge area. From the aspect of biology [2] to the aspect of engineering [1], the concept of modularity can be applied. The modularity concept is not limited to any aspect. It can come in many forms such as for an example the light bulb in figure 2.1

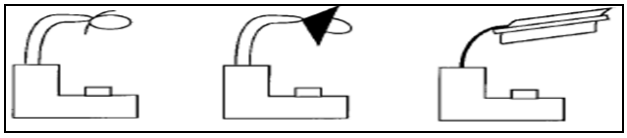

Figure 2.1: Modularity in light bulb

All three lamps is the same type but it can be changes due to needs and function. The modularity concept gives the user the power to decide the needs and requirement they wanted. By this concept also, the user can save their money because of modular products, designing and assembly of the item is at a low cost. [1]

2.3 MODULAR TABLE

Modularity is an approach aiming to subdivide a system into smaller parts (modules) that can be independently created and then used in different systems to drive multiple functionalities. Besides reduction in cost (due to lesser customization, and less learning time), and flexibility in design, modularity offers other benefits such as extension (adding new solution by merely plugging in a new module), and exclusion.

As for table, it is a form of furniture made of a surface and supported by a base, usually four legs. It is often used to hold objects or food at a convenient or comfortable height when sitting.

When both of the terms combined together, it give the meaning of a form of furniture that capable to be subdivide into smaller parts that can be independently created and then used in different systems.

2.3 FUNCTION OF TABLE

A table can be used temporarily for objects such as food and eating utensils during a meal, cups for drinks, a book, a spread-out map, writing paper during writing, and anything that requires having several objects at hand, including various hobbies. Tables are frequently used to place small items on such as key chains or pens until further use. Things also can be put permanently on a table, for example a TV, computer, decoration and etc. Table settings of food are laid out in a traditional arrangement.

2.4 HISTORY OF TABLE

Some very early tables were made and used by the Egyptians and the design in that time just basic. They were not used for seating people. Food was put on large plates deposed on a pedestal for eating. The Egyptians made use of various small tables and elevated playing boards. The Chinese also created very early tables in order to pursue the arts of writing and painting.

The two ancient empires, the Greeks and the Romans, widely use the table in their daily life, especially for eating, although Greek tables were pushed under a bed after use. The Greeks created a piece of furniture that similar to the guéridon (a small, often circular center table supported by one or more columns, or sculptural human, or mythological figures). Tables were made of marble or wood and metal (usually bronze or silver alloys). Later, the larger rectangular tables were made of separate platforms and pillars. The Romans also introduced a large, semicircular table to Italy, the *mensa lunata*.

Furniture during the middle Ages is not as well-known as that of earlier or later periods, and the luxury design table was used by the nobility. In the Eastern Roman Empire, tables were made of metal or wood, usually with four feet and frequently linked by x-shaped stretchers. Tables for eating were large and often round or semicircular. A combination of a small round table and a lectern (a reading desk with a slanted top, usually placed on a stand or affixed to some other form of support, on which documents or books are placed as support for reading aloud) seemed very popular as a writing table. In Western Europe, the invasions and intestine wars caused most of the knowledge inherited from the classical era to be lost. As a result of the necessary movability, most tables were simple trestle tables, although small round tables made from joinery reappeared during the 15th century and onward. In the Gothic era, the chest (furniture) became widespread and was often used as a table.

Refectory tables first appeared at least as early as the 16th century, as the evolution of the trestle table; these tables were typically quite long and capable of supporting a sizeable banquet in the great hall or other reception room of a castle.

2.5 TYPES OF MODULAR TABLE

2.5.1 The Modular Concrete Picnic Table [6]

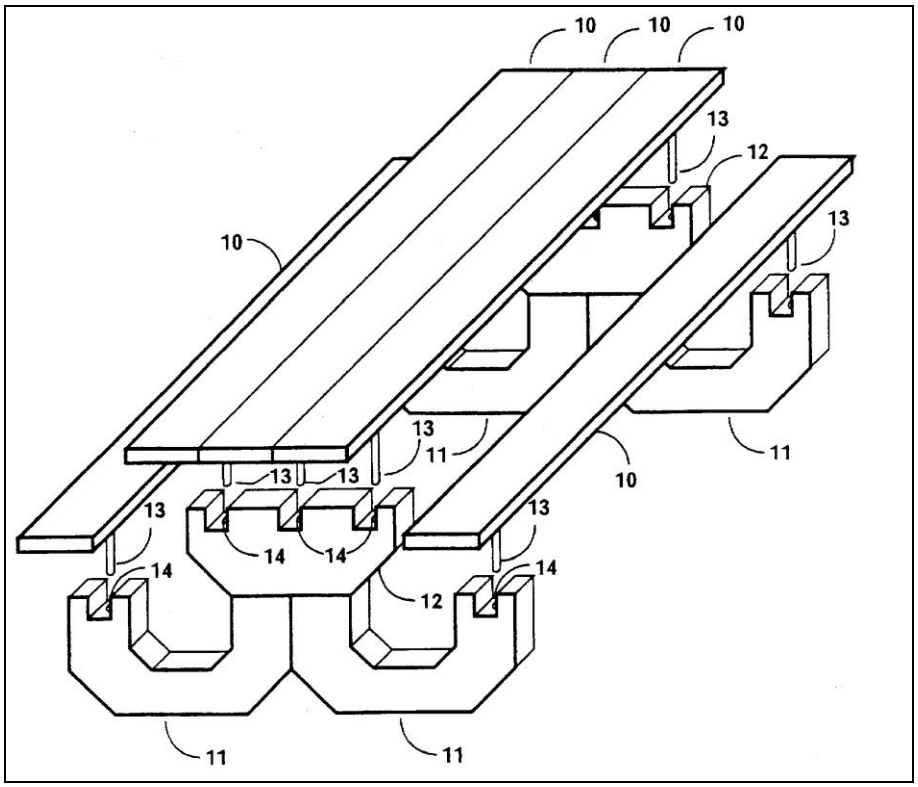

Figure 2.2: Modular Concrete Picnic Table

According to this table inventor, Roesner, Dean G, he claims that the table in figure 2.2 (dimension units in inch) is a modular pre-cast concrete picnic table (United States Patent 5752450) which can be firmly assembled and disassembled into sections comprising two end sections.

He also claims that this design has some advantages over the old model of picnic table. For an example, compared to the previous art, this table is a unique combination of stability, durability, portability, maintainability and cost effectiveness of materials, as well as being remarkably simple to assemble and disassemble. He also claims that the modular, eleven piece constructions lends itself to easy transportation, even to the point that all parts can be easily carried by two or fewer people, which make it even more unique considering the structure of the table, were made out of concrete. The table also able to be repair if any of the components is damage; the design allows easy replacement of damaged parts through ease of assembly and disassembly and commonality of parts as well as the feature of person portability of all parts.

2.5.2 Self-Leveling Modular Table [9]

In this invention, the inventor (United States Patent 6382109), Leon Novikoff, has design a table that has the capability to form into various shapes and sizes. It is also capable to self leveling. It is the renovation of the current table but the modular table is easy to use and it is economical. It reflects the beauty and professionalism once it is put together.

His invention is due to problems that faced in restaurant and office where sometimes having problems to join the available table to have a bigger area that can support more people at a time. So, he uses the concept of modularity to design the table. He claims that even though there are a lot ready-to-assemble table in the current market, but sometimes the table doesn't as good as factory-assemble table. The ready-to-assemble table tends to loosen up or come apart after extended use.

2.5.3 Articulated Modular Table [7]

Whitesitt, Scott W. is the pattern holder for articulated modular table (United States Patent 6497184) in figure 2.3 (dimension units in inch). His design are based on the reason of the versatility of a normal table are limited. He also said that modular table is a table that able to be arranged and locked in different configuration or design. The shape of the table isn't fixed and can be change according needs and function.

These are advantages that he claims for his articulated modular table. Firstly, the table able to provide an articulating arrangement of two coplanar works surfaces of next tables that can be moved into various positions. Next, he said that the table able to be moved to different location by only one person without much difficulty. Then, the table is said able to be arranged to various geometry arrangements so that it can maximize the usage of provided room.

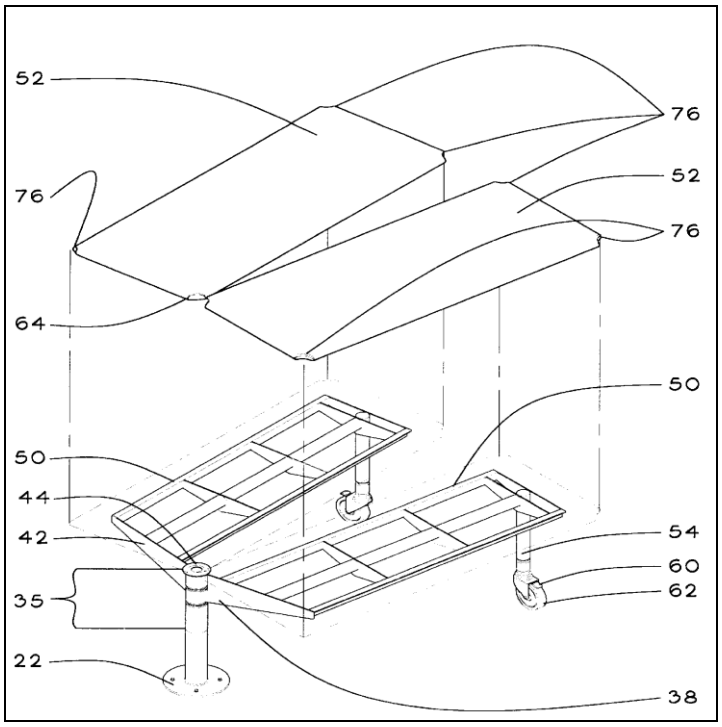

Figure 2.3: Articulated modular table

2.5.4 Modular Picnic Table [8]

The inventor of this product shown in figure 2.4 (dimension units in inch) **(**United States Patent 6978723), Dodd, Dolphus A., claims that it is essential for a picnic table to use modular design in the product because with a modular design, the table is able to be stored easily when it is not been used. The reason for this inventor wanted his table able to store easily is because he wanted to avoid the factors that can shorten the durability of the table such as sun's ray, rain, wind, and others.

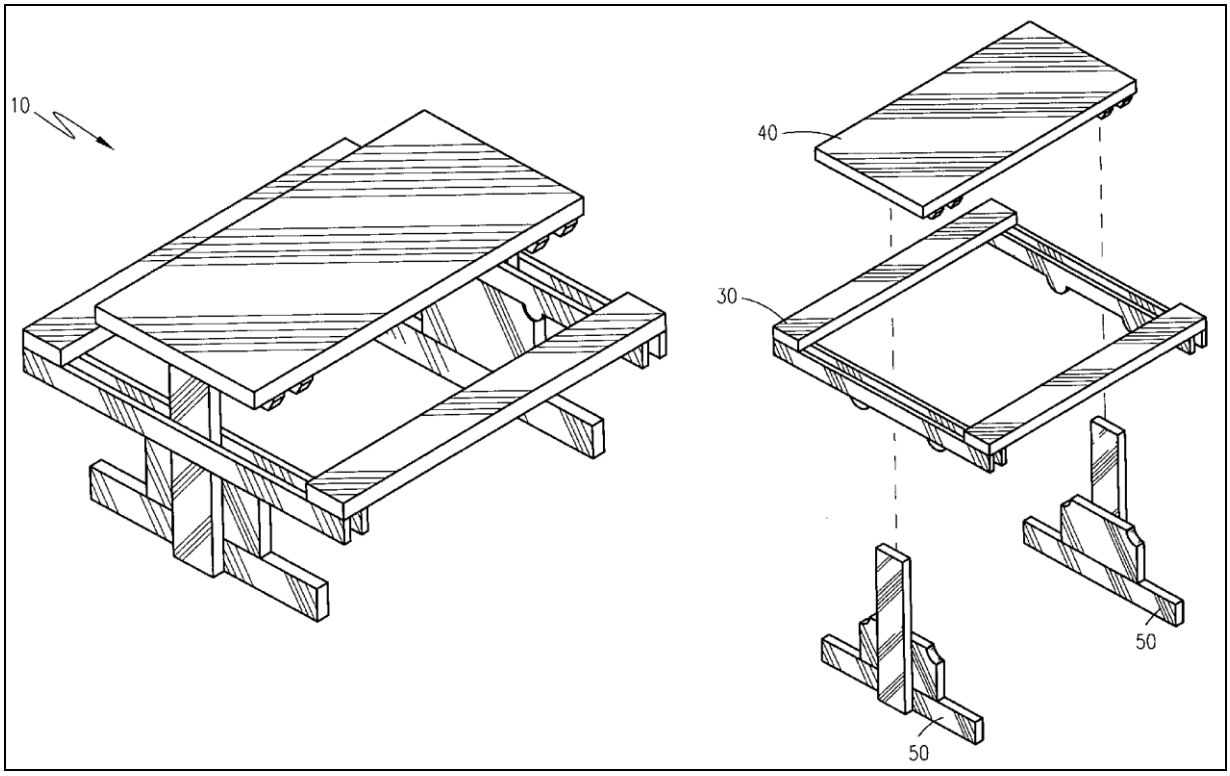

Figure 2.4: Modular Picnic Table

2.6 MODULAR STUDY TABLE

In this project, the basic idea is to create a table that specifically for studying purpose that uses the concept of modularity, in this case, it's surface size can be adjusted from time to time depending on the amount of user that want to use it. Its surface can be expand or shrink.

Limited space provided by normal table didn't give the user flexibility to use the table. The user is bounded to limited workspace. He or she cannot exceed the space provided when putting item, books, or event tools required for the studying session.

Limited space also means that the number of person allowed to be at the table is limited. For a small study table, it may be possible to support one or two user at a time, but as the amount of user increases, it is impossible to provide a proper studying area for the users. Much larger table required to support the amount of user.

The fix amount of area that provided by the normal table couldn't give the user the flexibility to use it. The user may not experiencing any problem if the studying session only involve books, but if the user desire to included something larger than the books, for an example, a drawing board. If the table area is big, it wouldn't be a problem but if the area is just only for normal study, it also can bring a little bit problems in the studying process.

That's why this modular studying table ware proposed. Its purpose is to minimize the entire above problem. The concept of modularity itself in this project allows the user to determine the condition of the table, the size of the table and the purpose of the session, whether it is for personal study or it is a discussion session. The modular study table can provide the required condition for above problems